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Impact of water management, weed and integrated nutrient management on weed parameters and yield of potato (*Solanum tuberosum*)

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ABSTRACT : A field experiment was conducted at Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G) during *Rabi* 2010-11 and 2011-12. The soil of experimental site was clay loam in texture, neutral in soil reaction. The climate of the region is sub humid with an average annual rainfall of 1200-1400 mm. Results revealed that minimum total weed density and total weed dry weight was found under drip irrigation (100 % of OPE) at all stages during both the years and on mean basis, yield attributes and total tuber yield of potato crop was significantly maximum under drip irrigation (125 % of OPE) as compared to furrow irrigation. The herbicide metribuzin (500 g a.i. ha^{-1} PE) proved better among other weed management practices recorded minimum total weed density and total weed dry weight was found at all stages and the maximum yield attributes and total tuber yield of potato crop. Application of 75% N inorganic fertilizer + 25 % N organic (Poultry manure) + PSB + *Azotobacter* was found non significant to weed control while produced significantly highest yield attributes and total tuber yield.

KEY WORDS : Drip irrigation, Weed management, Integrated nutrient management, Potato

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Potato (*Solanum tuberosum*) is the most important food and vegetable cum starch supplying crop of the world. It is one of the most remunerative and profitable crop for the growers due to its higher yield potential within a limited time. Water is the vital source for crop production and is the most limiting factor in Indian agricultural scenario. Though India has the largest irrigation network, the irrigation efficiency has not been achieved more than 40 per cent. Due to water scarcity, the available water resources should be very effectively utilized through water saving irrigation technologies. Hence, further expansion of irrigation may depend upon the adoption of new systems such as pressurized irrigation methods with the limited water resources. Amongst those pressurized irrigation methods, drip irrigation has proved its superiority over other methods of irrigation due to the direct application of water and nutrients in the vicinity of root zone. There are several constraints in potato production, of which weeds often pose a serious problem. Weeds not only compete with crop plants for nutrients, soil moisture, space and sunlight but also serve as an alternative hosts for several insect pest and diseases. Hand weeding and hoeing are common practices followed in India. However, timely weed control may not be possible manually due to non-availability of labours and high rate of wages during peak period of farm operations. Hence, chemical weed control appears to hold a great promise in dealing with effective, timely and economic weed suppression. The overall strategy for increasing potato yields and sustaining them at a high level must include an integrated approach to the management of soil nutrients, along with other complementary measures.

RESEARCH METHODS

A field experiment was conducted at Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G) during *Rabi* 2010-11 and 2011-12. The soil of experimental site was clay loam in texture, neutral in soil reaction, low in available N, low in available P and high in available K status. The climate of the region is sub humid with an average annual rainfall of 1200-1400 mm. The crop received 63.7 mm rainfall during crop period. The experiment was laid out in split–split plot design with three replications. The treatments consisted of three irrigation schedule *i.e.* drip irrigation (125 % of OPE), drip irrigation (100 % of OPE) and control (furrow irrigation) as a main plot and four weed management *i.e.* weedy check, hand weeding (at 25 and 45 DAP) metribuzin (500 g a.i. ha^{-1} PE) and chlorimuron + quizalofop (6 + 50 g a.i ha^{-1}) at 20 DAP as sub plot and four integrated nutrient management *i.e.* 100 % RDF, 100 % RDF + micro nutrient (Zinc sulphate 25 kg ha^{-1}), 75 % N inorganic fertilizer + 25 % N poultry manure + PSB + *Azatobacter* and 50 % N inorganic fertilizer + 50 % N poultry manure + PSB + *Azatobacter* as sub sub plot. Kufri Chipsona- 2 variety was used for experiment.

RESEARCH FINDINGS AND DISCUSSION

The results obtained from the present investigation are summarized below :

Weed parameters:

Weed species:

The major weed species existed in the experimental area were *Chenopodium album, Convolvulus arvensis, Melilotus*

Table 1 : In the experimental field following weed species or weed flora were found predominant

Sr. No.	Group	Botanical name	Family	Vernacular name
1.	Broad leaf weeds	*Chenopodium album*	Fabaceae	Bathua
2.		*Convolvulus arvensis*	Convolvulaceae	Hirankhuri
3.		*Melilotus alba*	Fabaceae	Safed senji
4.		*Medicago denticulata*	Fabaceae	Chinori
5.	Grasses	*Cynodon dactylon*	Poaceae	Doob

Table 2 : Effect of irrigation schedule, weed and integrated nutrient management on weed density (No.m^{-2}) and weed dry weight (g m^{-2}) in potato at 60 DAP

Treatments	Weed density at 60 DAP (No. m^{-2})			Weed dry weight at 60 DAP (g m^{-2})		
	Total weed density 2010-11	Total weed density 2011-12	Mean weed density Mean	Total weed dry weight 2010-11	Total weed dry weight 2011-12	Mean weed dry weight Mean
Irrigation schedule						
I_1 – 100% OPE (Open Pan Evaporation)	2.88 (8.86)	3.15 (11.26)	3.03 (10.06)	3.06 (9.56)	3.09 (10.13)	3.09 (9.85)
I_2 – 125% OPE	3.15(10.49)	3.58 (14.10)	3.39 (12.30)	3.39 (11.47)	3.37 (11.79)	3.39 (11.63)
I_3 – Control (Furrow irrigation)	4.76(26.37)	5.52 (36.14)	5.16 (31.26)	4.43 (21.42)	4.81 (25.16)	4.64 (23.29)
S.E.±	0.05	0.04	0.04	0.10	0.10	0.09
C.D. (P = 0.05)	0.19	0.15	0.14	0.37	0.40	0.33
Weed management						
W_0 – Weedy check	5.60 (33.78)	6.55 (46.48)	6.10 (40.13)	5.03 (26.48)	5.32 (29.55)	5.18 (28.01)
W_1 – Hand weeding at 25 and 45 DAP	2.88 (8.05)	3.40 (12.25)	3.16 (10.37)	3.07 (9.33)	3.19 (10.31)	3.14 (9.82)
W_2 – Metribuzin (500g a.i ha^{-1}. PE)	2.09 (4.06)	2.09 (4.36)	2.11 (4.21)	2.63 (6.70)	2.45 (6.24)	2.57 (6.46)
W_3 – Chlorimuron (CMS) + quizalofop (6+50g a.i ha^{-1}) at 20DAP	3.82 (14.62)	4.28 (18.92)	4.07 (16.77)	3.78 (14.10)	4.07 (16.67)	3.93 (15.39)
S.E.±	0.05	0.11	0.07	0.07	0.10	0.07
C.D. (P = 0.05)	0.14	0.33	0.20	0.21	0.31	0.22
Integrated nutrient management						
F_1 – 100% RDF	3.73 (16.22)	4.22 (21.41)	3.99 (18.82)	3.73 (14.78)	3.90 (16.75)	3.83 (15.77)
F_2 - 100% RDF + micro nutrient (Zinc sulphate 25 kg ha^{-1})	3.57 (14.93)	4.09 (20.25)	3.85 (17.59)	3.64 (14.19)	3.71 (15.16)	3.68 (14.67)
F_3 – 75% N inorganic fertilizer + 25% N poultry manure + PSB + *Azotobacter*	3.52 (14.82)	3.96 (20.08)	3.76 (17.45)	3.55 (13.81)	3.70 (15.51)	3.65 (14.66)
F_4 – 50% N inorganic fertilizer + 50% N poultry manure + PSB + *Azotobacter*	3.58 (14.99)	4.05 (20.26)	3.83 (17.62)	3.59 (13.82)	3.73 (15.34)	3.67 (14.58)
S.E.±	0.05	0.09	0.06	0.06	0.08	0.06
C.D. (P = 0.05)	NS	NS	NS	NS	NS	NS

Note : The figures in parenthesis indicate the original values NS=Non-significant

alba, *Medicago denticulata*, *Cynodon dactylon* and others etc. (Table 1). Out of five weed species, *Chenopodium album*, *Convolvulus arvensis*, *Melilotus alba*, *Medicago denticulata* among the broad leaf weeds and *Cynodon dactylon* among grasses were predominant.

Weed density and weed dry weight:

It was observed that the total weed density was significantly higher under furrow irrigation at all stages during both the years and on mean basis as compared to others. However, minimum total weed density was found under drip irrigation (100 % of OPE) at all stages during both the years and on mean basis (Table 2).

The data reveal that significantly lowest weed density and weed dry weight m^{-2} were found with the application of metribuzin (500 g a.i. ha^{-1} PE) followed by two hand weeding at 25 and 45 DAP compared to weedy check. The maximum weed population and weed biomass was found under weedy check condition which adversely affected the growth and yield of potato crop. Integrated nutrient management was found non significant during both the years as well as in mean data. Similar findings were also reported by Jan *et al*. (2004), Singh *et al*. (2002) and Roder *et al*. (2009).

Table 3 : Effect of irrigation schedule, weed and integrated nutrient management on number of stolons, number of tubers and tuber yield of potato crop

Treatments	Number of stolons plant^{-1}			Number of tubers plant^{-1}			Tuber yield (t ha^{-1})		
	2010-11	2011-12	Mean	2010-11	2011-12	Mean	2010-11	2011-12	Mean
Irrigation schedule									
I_1 – 100% OPE (Open pan evaporation)	26.47	29.38	27.91	12.43	15.63	14.03	30.16	31.24	30.59
I_2 – 125% OPE	26.98	29.72	28.35	13.00	16.13	14.57	31.02	32.01	31.49
I_3 – Control (Furrow irrigation)	24.37	26.39	25.37	9.15	11.56	10.35	20.74	21.68	21.21
S.E.±	0.13	0.36	0.17	0.23	0.18	0.20	0.23	0.24	0.23
C.D. (P = 0.05)	0.53	1.41	0.66	0.90	0.72	0.78	0.91	0.93	0.92
Weed management									
W_0 – Weedy check	24.44	26.19	25.30	10.14	12.90	11.52	24.81	25.68	25.25
W_1 – Hand weeding at 25 and 45 DAP	26.35	28.88	27.59	12.30	15.04	13.67	28.57	29.48	28.96
W_2 – Metribuzin (500g a.i ha^{-1}. PE)	26.86	30.83	28.85	12.95	16.28	14.62	29.51	30.60	29.99
W_3 – Chlorimuron (CMS) + quizalofop (6+50g a.i ha^{-1}) at 20DAP	26.11	28.10	27.10	10.71	13.54	12.13	26.33	27.47	26.87
S.E.±	0.13	0.24	0.16	0.12	0.14	0.13	0.19	0.20	0.20
C.D. (P = 0.05)	0.39	0.74	0.49	0.37	0.43	0.39	0.57	0.59	0.59
Integrated nutrient management									
F_1 – 100% RDF	24.82	27.17	25.97	10.50	13.49	12.00	24.85	25.82	25.30
F_2 - 100% RDF + micro nutrient (Zinc sulphate 25 kg ha^{-1})	25.51	28.11	26.81	10.87	13.82	12.35	26.61	27.63	27.08
F_3 – 75% N inorganic fertilizer + 25% N poultry manure + PSB + *Azotobacter*	27.70	30.52	29.11	13.55	16.54	15.05	30.45	31.58	30.96
F_4 – 50% N inorganic fertilizer + 50% N poultry manure + PSB + *Azotobacter*	25.73	28.19	26.95	11.18	13.91	12.55	27.31	28.23	27.73
S.E.±	0.16	0.24	0.17	0.18	0.17	0.17	0.273	0.26	0.26
C.D. (P = 0.05)	0.45	0.69	0.49	0.52	0.49	0.48	0.769	0.75	0.73

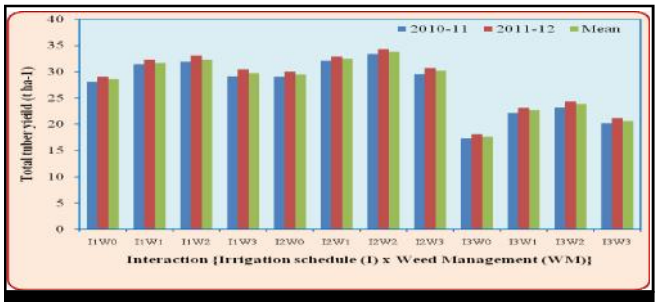

Fig. 1 : Effect of interaction between irrigation schedule (I) and weed management (W) on total tuber yield of potato (t ha^{-1})

Yield attributes and yield:

Irrigation schedule positively influenced the yield attributes and yield (Table 3). The number of stolons plant^{-1}, number of tubers plant^{-1} and tuber yield were significantly higher under drip irrigation (125 % of open pan evaporation) than control (furrow irrigation) but was at par with drip irrigation (100 % of open pan evaporation) during both the years and on mean basis. The higher yield attributing characters and yield was noticed in the above treatment which might be due to availability of water in sufficient quantity.

Among weed management practices, the number of stolons plant^{-1}, number of tubers plant^{-1} and tuber yield were significantly higher under metribuzin (500 g a.i. ha^{-1}PE) than weedy check and rest of the treatments. Significantly higher yield attributing characters *i.e.* number of stolons, tubers and tuber yield were found under treatment 75% N inorganic fertilizer + 25 % N organic (Poultry manure) + PSB + *Azotobacter* than other nutrient management practices during both the years and on mean basis. These findings are in agreement with those reported earlier by Arora *et al*. (2009), Bakeer *et al*. (2009) and Baishya *et al*. (2010).

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